SIMULATED SPACE ENVIRONMENT EFFECTS ON TETHER MATERIALS WITH PROTECTIVE COATINGS

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ABSTRACT

Atomic oxygen (AO) erodes most organic materials, and ultraviolet radiation embrittles polymers. A previous study[1] indicated untreated polymers such as ultra-high molecular weight polyethylene (UHMWPE) are severely degraded when exposed to AO (fig. 1). This test series was performed to determine the effect of AO and UV on the mechanical integrity of tether materials that were treated with AO-protective coatings.

Three coating systems were evaluated for their ability to protect the underlying material from AO erosion. The first coating system is the Photosil surface modification process which incorporates silicon-containing functional groups into the top micron of an organic material. The Photosil process has had favorable results with polyurethane- and epoxy-based thermal control coatings[2]. The second coating system is metallization, in this case nickel. The third coating system is silsesquioxane. The Marshall Space Flight Center Atomic Oxygen Beam Facility (AOBF) (fig. 2) was used to simulate low Earth orbit AO of 5 eV energy. In addition, some tether samples were exposed to ultraviolet radiation then evaluated for any changes in mechanical strength.

Tether missions, such as a momentum-exchange/electrodynamic reboost (MXER) tether, may benefit from this research.

References

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2. "Simulated Space Environment Exposure of Surface-Modified Thermal Control Coatings"; J. Kleiman, Y. Gudimenko, Z. A. Iskanderova, A. Grigorevski, M. Finckenor, and D. Edwards. 42nd Aerospace Sciences Meeting, Reno, NV, Jan. 2004. AIAA-2004-1258.

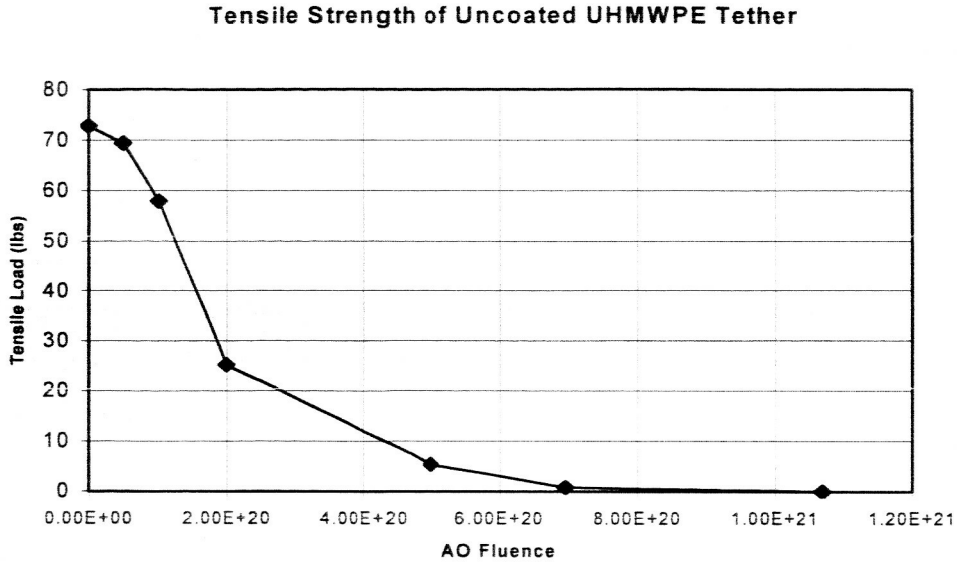

Figure 1. Atomic Oxygen Effects on Tether Tensile Strength

Figure 2. MSFC Atomic Oxygen Beam Facility